Afropolitan Journals

ISSN: 3027-2882 www.afropolitanjournals.com

Estimation of Some Major and Trace Elements in Human Hair in the Vicinity of Ashaka Cement Factory, Gombe State, Nigeria

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DOI: *https://doi.org/10.62154/qfrte071*

Abstract

This study aimed to estimate some major and trace elements in human hair samples obtained from human living at the vicinity of Ashaka Cement Factory, Gombe State to identify the proportion of some major and trace elements in human hair samples. The samples collected from human were kept in air tight polyethene-bags immediately. Then, they were washed with detergent to remove external dust and socked in distilled water for 10 minutes and transferred it into Acetone to remove stubborn dirty. The samples were analyzed using atomic absorption spectrometry (AAS) after several processes of determination and the graphical solution were plotted using MATLAB software package 2018a. The result of the analysis shows that 0.0091 ± 0.184, $0.169 \pm 0.15, 0.16 \pm 0.0102, 0.0014 \pm 0.0025\, mg/kg$ for Ca, Fe, Mg, Na and $0.085 \pm 0.38, 0.0049 \pm 0.0046, 0.0091 \pm 0.0029, 0.099 \pm 0.0069\, mg/kg$ for Pb, Cu, Zn, Cd in human hair samples obtained in the vicinity of Ashaka cement factory. The finding of the study is greatly importance to the entire society, especially those in the area of Ashaka cement factory and it also informs people on the positive and negative effects of trace elements in human life. Based on this result, it is recommended amongst other things that, there should be need for a study on the assessment in elements content of cement dusts using variety of analytical approaches since; some of the elements such as $Al, Si, Ni, and\ Hg$ were not detected in the sample obtained in the study using atomic absorption spectrometry.

Keywords: Human Hair, Cement, Trace Element, Major Element, Bioaccumulation Factor.

Introduction

Oxford dictionary sees as Hair as of the fine threadlike strands growing from the skin of human, mammals, and some other animals. Hair has a unique potential to reveal retrospective information about the nutritional status and exposure of subjects (Sela *et al.*, 2007). Grows approximately 1cm a month, Trace elements are incorporated into hair during the growth process and reflect the composition of trace elements in blood plasma at the time of This also formation (Benner and Levin, 2005). Agreed that hair grows approximately 1cm a month, and that trace element composition in hair reflects blood levels at the time the hair was generated. (Shermberger2002). He further agreed that Blood and urine analysis, on the other hand, reflects the trace elements status only at the time the sample was obtained and then important information in several historical or forensic cases have been obtained from hair. The levels analyses (Shamberger2002). of elements in human hair are important implications that serve as a useful adjunct biochemical index for assessing elements the burden in human body (Ibrahim *et al.*, 1997). The bio-monitoring of hair assessment has the advantage of detecting element variation which represents the long-term historical exposure trend and recent exposure of the individual when compared to urine and blood engaged to observe the current element status of the human body. Hair is widely accepted for many advantages to evaluate the relation between essential elements in body burden and disease (Brar *et al.*, 2006).

Statement of the Problem

Other researchers have shown major and trace elements concentrations in River Gongola of Adamawa State, Nigeria. These were assessed using Atomic Absorption Spectrophotometer (AAS). Their study revealed high concentrations of heavy metals and trace elements in the water samples from different sampling sites with the exception of copper whose concentration was within the permissible limit. Therefore, this study intends to carry out a research on major and trace elements concentrations in the industrial area of Ashaka Cement Factory released cement dust in to the environment during cement production process, which generates major and trace elements contents in human hairs leaves within the environment.

Aim and Objectives of the Study

This study is aimed at estimating of trace elements and major elements in human hair in the vicinity of Ashaka Cements Factory. The objectives of the study are specifically sought to include;

i. The determination of the presence of trace elements in human hair
ii. The determination of the presence of major elements in human hair

Research Questions

The following research questions to be answered to guide the study;

i. i What is the proportion of trace elements in human hairs?
ii. What is the proportion of major elements (Ca, Fe and Mg) in human hairs?

Location of the Study

Ashaka Cement Company was established in 1976 in Jalingo village of Bajoga Local Government Area of Gombe State, Nigeria. The company was established to meet the needs of contraction works in the North-Eastern part of Nigeria. It has an installed capacity of 500,000 MT per annum (NSE, 2004). It is located in the Northern part of Gombe and lies between latitudes 10°45′N and 11°00′N and longitudes 11°15′E-11°30′E9. The company produces a huge amount of dust and gaseous pollutants to the environment. The Google map of Ashaka cement factory is given as:

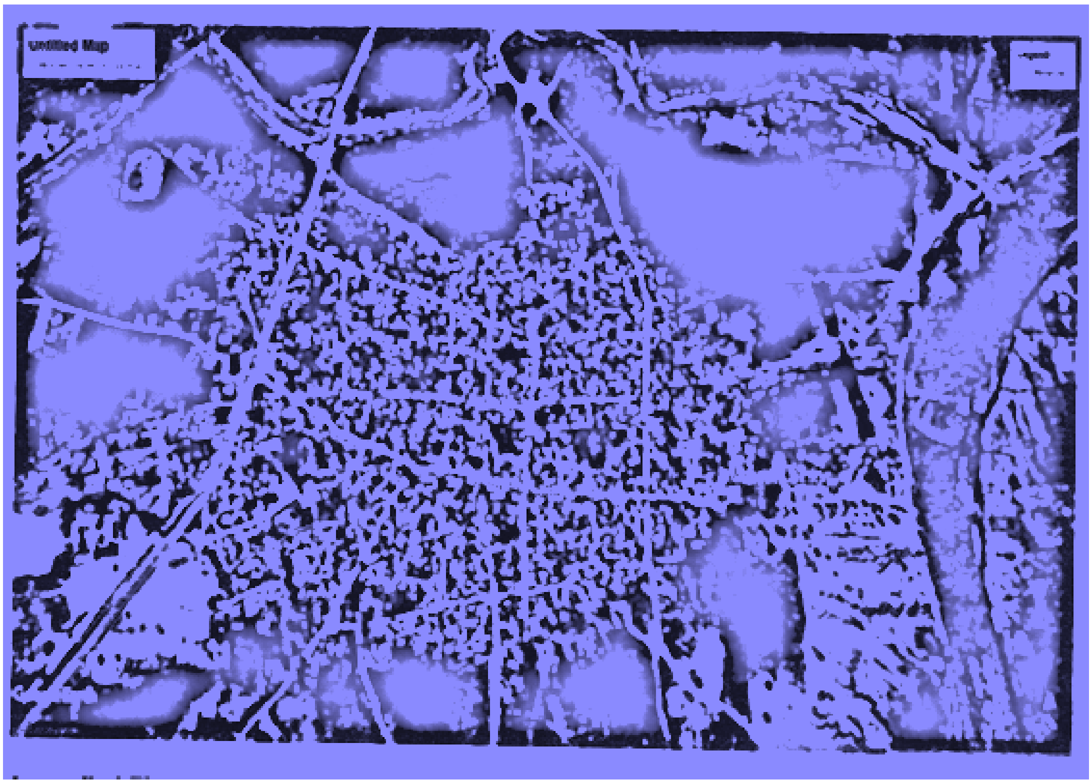

Figure 1. Google map of Ashaka cement company

Materials and Methods

In the preparation of reagents, chemicals of analytical grade and distilled water were used. The following materials were used during the course of this research: Human Hair, was collected and stored in plastic rubber, distilled water, Hot air Oven, concentrated Trioxonirate (v) acid and atomic absorption spectrometer (AAS) analyzer. The study adopted and modifies the (Eltayeb and Van Grieken 1989), method of sample collection: Hair samples collection was from different subjects within Ashaka Cement Factory Metropolis Gombe State, Nigeria. The hair samples collected were sealed in plastic bags prior to analysis. The washing procedure employed was that m of Mandal *et al.,* 2003.Was adopted and slightly modified. The hair samples were cut into pieces so as to ensure feasible and fast digestion of the samples. Hair samples were pre-washed with detergent and soaked in deionized water for 10 minutes. It was followed by soaking in acetone to remove external contamination and finally the hair samples were washed with deionized water. The samples were dried in an oven at 110 °Cfor 1 hour and finally kept in a desiccator pending digestion. The samples were prepared in line with the procedure recommended by the International Atomic Energy Agency (IAEA). acetone (Ryabukhin, 1978). The hair samples were washed in acetone, three portions of water and again with acetone (Ryabukhin, 1978). The IAEA method was applied in the present study for hair washing, 3g of each of the hair samples were weighed into a clean crucible and was dried in an oven to partial dryness to avoid explosion. The dried hair sample were digested with 10ml of 6:1 mixture of concentrated Trioxonitrate(v) acid and monochloride acid. The mixture was heated until near complete evaporation to obtain a water clear solution. Each digested sample was transferred into a 100 ml volumetric flask and made up to the mark with distilled water. The method adopted of (Morton *et al*., 2002).

Determination of Elements Using Atomic Absorption Spectrometry (AAS)

Previously washed samples of human hair were cut in to 0.5-1cm long portion which were then weighed three times to within 1,0 ± 0,1 g. Acid digestion of samples was performed with concentrated HNO_3 adding 1ml 30% H_2O_2. The solution was filtered and the contents quantitatively transferred to a 50 ml volumetric flask. Distilled water was added until the volumetric flasks were filled to the mark. These prepared solutions were used for determination of metals using the method of atomic absorption spectrometry, flame technique. The procedure of the sample ashing: the hair was weighed in a quartz cup after washing (m~200 mg). The ashing was carried out in two steps: (1) 250°C, 15 minutes; (2) 450-500°C, 2-2.5 hours. Further, the furnace was cooled to the room temperature.

Result and Discussion

The results from the analysis of this study were presented as;

Table 1: Major element level in human hair sample from the vicinity of Ashaka Cement Factory.

Elements	Proportion	Rank
Ca	0.165	1^{s}
Fe	0.084	2^{nd}
Mg	0.055	4^{th}
Na	0.062	3^{rd}

(Authors computation)

From table 1, above shows the major elements levels in human hair sample. In the value of Calcium is higher than the control samples. This may be due to the higher concentration of Calcium contents in cement dust with the following values 0.18±0.12mg/kg for Calcium compared to the control sample of 0.043±0.02mg/kg, followed by Iron which has 0.12±0.08mg/kg while the control sample has is 0.05±0.04mg/kg. They were followed by Sodium with 0.06±0.05mg/kg and the control samples. 0.03±0.04mg/kg. Then Magnesium has the following values 0.5±0.4mg/kg and its control samples has the following value 0.022±0.02mg/kg. The results of experimental measurements, obtained in the study are similar to the values obtained in other work by kabir (2010) , when he studied the samples in locality. And presented it graphically as;

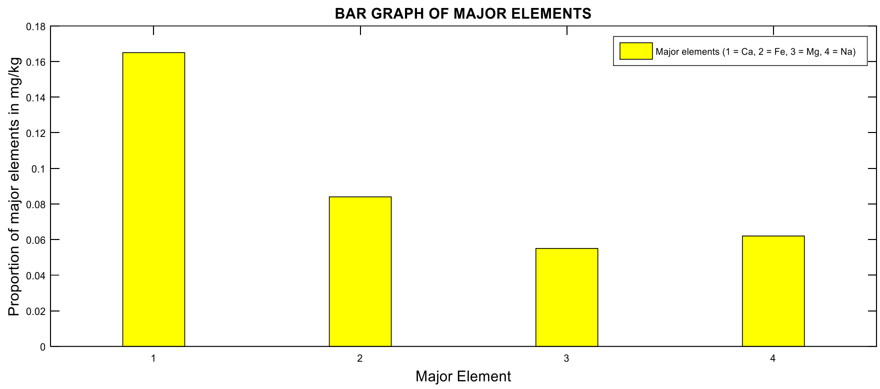

Figure 1: Results of major elements level in mg/kg of human hair

Table 2: Trace element level in human hair sample from the vicinity of Ashaka Cement Factory.

Elements	Proportion	Rank
Pb	0.0034	2nd
Cu	0.00039	3rd
Zn	0.0042	1st
Cd	0.00015	4th

(Authors computation)

From the table .2, the result shows that the trace elements level in human hair samples obtained from the study area, Zinc has the highest concentration of 0.0075±0.005mg/kg and its control sample with the following values 0.00003±0.002mg/kg. zinc was followed by Lead with the following values 0.004±0.001mg/kg and control sample with 0.0002±0.00027mg/kg, then Copper which has 0.007±0.001mg/kg and the control value 0.00005±0.00001mg/kg while cadmium has the least concentration in the samples studied. A slightly higher concentration of Cadmium 0.003mg/kg was found in exposed area compared to the mean value of Cadmium found in the control hair sample which was 0.0002mg/kg. All the concentration fell within the WHO standard concentration Biolab medical unit 2010. And presented it graphically as;

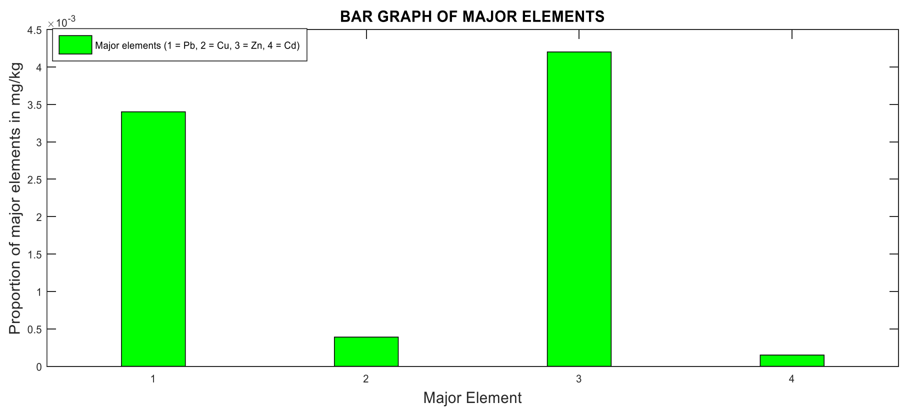

Figure 2: Results of trace elements level in mg/kg of human hair

Table 3: Bioaccumulation Factor of Major Element in Human Hair Sample from the Vicinity of Ashaka Cement Factory.

Elements	Proportion	Rank
Ca	0.320	1st
Fe	0.166	2nd
Mg	0.110	4th
Na	0.120	3rd

(Authors computation)

From the table 3, the result shows that the bioaccumulation factor of major element level in human hair sample obtained in the vicinity of Ashaka cement factory, Calcium has the highest bioaccumulation factor with the following values 0.38±0.30mg/kg and 0.20±0.017mg/kg for the control sample. This was followed by Iron which has the following value 0.25±0.15mg/kg and the control sample as 0.016±0.45mg/kg Sodium has 0.2±0.08mg/kg and control value have 0.06±0.064mg/kg while Magnesium has lower accumulation in the sample obtained within the area of Ashaka cement factory, with the following values as 0.1±0.5mg/kg and 0.022±0.02mg/kg, for its control. It can be concluded that the value obtained in the samples were within the range of permissible limit of WHO 2006 which has the value of (0.01mg/kg. And presented it graphically as;

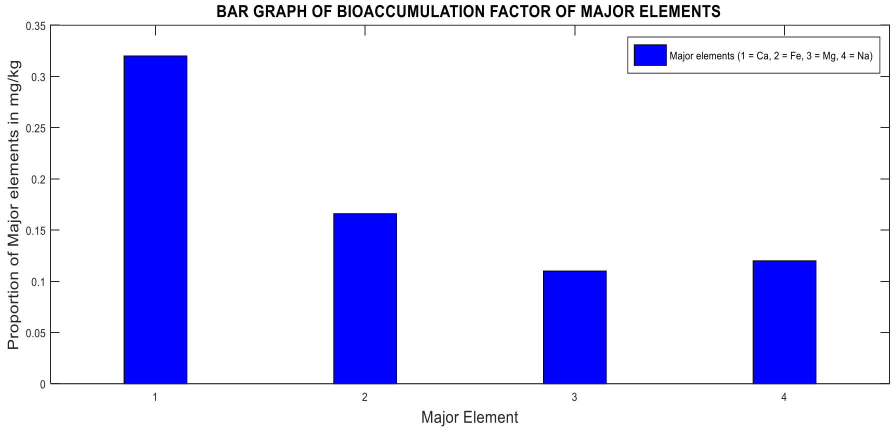

Figure 3: Bioaccumulation factor of major elements level in human hair

Table 4: Bioaccumulation Factor of Trace Element in Human Hair Sample from the Vicinity of Ashaka Cement Factory

Elements	Proportion	Rank
Pb	0.0150	2nd
Cu	0.0007	3rd
Zn	0.0870	1th
Cd	0.001	4th

(Authors computation)

From the table.4, shows, the result of bioaccumulation factor of trace element level in human hair sample obtained in the vicinity of Ashaka cement factory. Based on the result obtained Zinc has the highest accumulation factor than the remaining elements in the samples of study with the following values 0.028±0.03mg/kg and the control value as 0.01±0.003mg/kg, followed by Lead which has the following value as 0.0054±0.004mg/kg and its control with 0.002±0.003mg/kg. Then Cadmium has 0.002±0.001mg/kg and the control sample which has 0.0002±0.0001mg/kg and Copper has lower accumulation in the sample obtained with the following value as 0.001±0.002mg/kg, with its control having 0.00001±0.00005mg/kg. The concentration was slightly below the lower optimal concentration of copper, but within the range of normal value and fall within the recommended standard value of 0.01mg/kg WHO (2006). And presented graphically as;

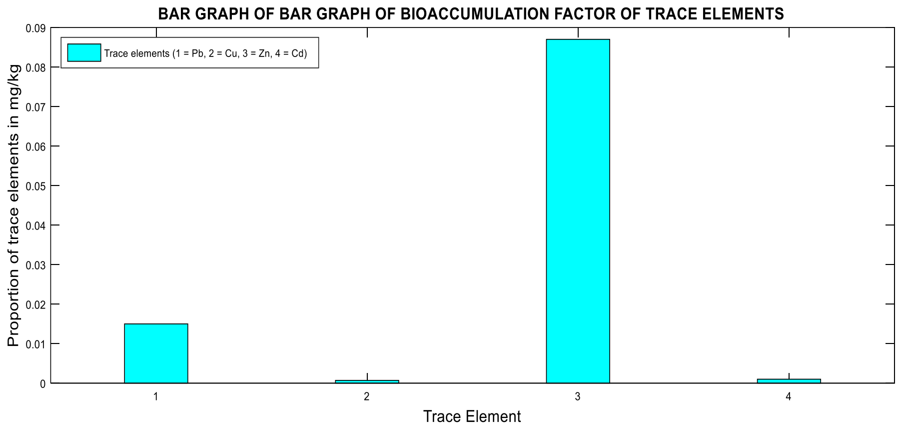

Figure 4: Bioaccumulation factor of trace elements level in human hair

Conclusion

After conducting data analysis on the samples, collected from the study area, significant presence of some major and trace elements at different levels of concentration of the elements were determined. It concluded that the value obtained in the samples were within the range of permissible limit, where the concentration of some element like copper was slightly below the lower optimal concentration of copper but it still within the range of normal value and fall within the recommended standard value of wealth health organization (WHO).

Recommendations

Based on the result from finding, the study has commended amongst other things that;

- There is a need for another study on the assessment of elements content of cement dust with another analytical instrument.
- There is a need for another research to identify on some of the elements such as Al, Si, Ni, and Hg from the same sample obtained in the study area using atomic absorption spectrometry (AAS).

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